Applied Psycholinguistics (2023), **44**, 265–291
doi:10.1017/S014271642300019X

CAMBRIDGE UNIVERSITY PRESS

ORIGINAL ARTICLE

Reading in kindergarten Arabic-speaking children with low linguistic skills: A longitudinal study

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(Received 26 August 2021; revised 20 December 2022; accepted 10 March 2023; first published online 04 April 2023)

Abstract

The present longitudinal study aimed to explore the connections between different linguistic profiles at kindergarten and reading achievements at first grade. These profiles are based on the two-dimensional model (Bishop & Snowling, 2004), which associates reading skills with phonological and other language abilities. This model was examined mainly in Indo-European languages but scarcely in Arabic. Arabic-speaking children were assigned to four linguistic profiles in kindergartens: low language (L_L; N = 111), low phonology (L_{Ph}; N = 120), low language and low phonology (L_LL_{Ph}; N = 139), and typical language and typical phonology (T_LT_{Ph}; N = 135). Multivariate analysis was used to compare their reading achievements at first grade, and the overlap between linguistic and reading profiles was estimated. The results revealed significant differences between the different linguistic profiles in all reading measures. L_LL_{Ph} group gained lower scores in reading tasks compared to the other groups. Significant relationships have been found between linguistic and reading profiles indicating reading difficulties among 14.5% of the children from T_LT_{Ph}, 63% of L_LL_{Ph}, 35% of L_L, and 35.6% of L_{Ph}. The findings support the relationship between low linguistic skills and reading difficulties and emphasize the potential roles of both phonological and language skills for reading.

Keywords: Arabic; phonological awareness (PA); language; reading skills; kindergarten; first-grade

A large body of evidence suggests that the basis of word reading process is essentially linguistic (Bishop & Snowling, 2004; Catts et al., 2005; Pennington & Lefly, 2001; Snowling, 2008; Snowling et al., 2003, 2019; Torppa et al., 2010). Phonological awareness (PA), the recognition that spoken words can be segmented into small units (Ziegler & Goswami, 2005), is one of the most studied linguistic domains

in the context of reading. According to the phonological sensitivity approach (as phrased by Dickinson et al., 2003), phonological skills explain a large portion of the variance in reading achievements (Snowling, 1998). Other language skills were also associated with word reading. These skills include i) semantic knowledge: word meanings, vocabulary size, and word definition, ii) morphological awareness: the ability to understand, use, and manipulate the smallest meaningful units such as root words, prefixes, and suffixes, iii) syntactic awareness which comprises a set of rules that mediate between word structures (e.g., word order, the rigidity of this order in the specific language, and the types of words), and iv) pragmatics that determine the manner subjects use their language in a communicative context and discourse (Toppelberg & Shapiro, 2000). The contribution of these language skills to basic reading skills has been reported across different tasks and languages (e.g., in English: Scarborough, 1990; in Finnish: Torppa et al., 2010; in Arabic: Abu-Rabia, 2007; El Akiki & Content, 2020; Schiff & Saiegh-Haddad, 2018; Taha & Taha, 2019; Tibi & Kirby, 2017, 2019; and in Hebrew: Schiff & Lotem, 2011).

This dissociation between phonological and language skills in the reading research inspired the central aim of the current study. Accordingly, four linguistic profiles have been established among Arabic-speaking kindergarteners assessing their reading achievement 1 year later at first grade. Below is an introduction of the association between developmental language disorders (DLDs) and dyslexia, followed by two theoretical frameworks regarding the language-reading relation (the two-dimensional model and the comprehensive language approach [CLA]), and summing up the introduction by a brief review of the Arabic language and the research questions and hypotheses.

DLD and dyslexia

The association between low linguistic skills and reading difficulties has led many researchers to examine the reading achievements of children with DLD and the linguistic levels of children with dyslexia (Bishop & Snowling, 2004; Catts et al., 2005). For example, previous studies showed that young adults (at ages 19–24 years) who were identified as DLD in childhood performed significantly worse than controls adults with no DLD background on learning measures, including reading (Snowling et al., 2000; Whitehouse et al., 2009; Young et al., 2002), spelling, and calculation (Young et al., 2002). According to Young et al (2002), 36.8% of the DLD group (diagnosed at the age of 5 years) met the criterion for reading disability in young adulthood. Higher percentages also met other learning disabilities' criteria (spelling and arithmetic). In another study, out of 102 English-speaking children aged 5–9 years diagnosed with language disorders, 51% were also reading-impaired, and out of 110 reading-impaired children, 55% also exhibited oral language impairment (McArthur et al., 2000). Furthermore, English-speaking children with DLD showed lower phonological scores compared to children at family risk of dyslexia, who in turn gained lower scores than typically developing children when followed longitudinally at ages 3–4 years and 4–5 years (Nash et al., 2013). However, only the children with DLD showed significantly lower scores in non-phonological broader linguistic skills compared to children with typical development and those at family risk of dyslexia.

https://doi.org/10.1017/S014271642300019X Published online by Cambridge University Press

A similar picture emerges when looking at the relation between reading and language disorders from the perspective of reading. Almost one-third of the children at family risk of dyslexia were also diagnosed as DLD at the age of 3.5 years (Nash et al., 2013). In the same vein, an earlier study had shown that English-speaking children (from dyslexic families) with reading impairment in second grade had significantly exhibited low syntactic scores at the age of 30 months beyond phonological and lexical measures (Scarborough, 1990). Looking at a broader age range (3:09 years, 6 years, and 8 years), 60% of children from a high family risk of dyslexia whose reading difficulties were verified displayed deficits in grammatical skills and vocabulary beyond their phonological deficits (Snowling et al., 2003). The relatively good reading skills of the remaining 40% of the children with a high family risk of dyslexia were explained by earlier preserved vocabulary and expressive language. The relatively good oral language skills in the early ages were considered as a semantic compensation and protective factor for reading (Snowling, 2008). In a retrospective study on Finnish, an orthographically highly transparent language, the analysis revealed significantly poor performance in receptive vocabulary and sentence length at the age of 2–2.5 years among reading disabled children in second grade compared to typical readers (Torppa et al., 2010). Reading-disabled children also showed poor performance in inflectional morphology, picture naming, phonological sensitivity, rapid naming (objects), and letter naming at the age of 3.5 years. The linguistic gap between reading disabled and typical readers was also found at the age of 5–5.5 years. Path analysis showed that inflectional morphology, and phonological processing, with letter naming and rapid naming, were the direct early predictors for later reading accuracy and fluency, whereas expressive and receptive language were indirectly related to reading.

Theoretical frameworks

Different models were proposed to describe and explain the relationship between language and reading (Bishop & Snowling, 2004; Catts et al., 2005; Kamhi & Catts, 1986). The *Two-Dimensional Model* (Bishop & Snowling, 2004) proposes that DLD and dyslexia are distinct disorders but share close behavioral similarities in phonological processing and word reading. Given the phonological shared deficit in DLD as well as reading deficits, children with low language skills were found to display a high risk for reading difficulties (McArthur et al., 2000; Nash et al., 2013; Scarborough, 1990; Snowling et al., 2000; Snowling et al., 2003). According to this model, the distinction between these disorders relates to the centrality of language difficulties in DLD compared to dyslexia. This model proposed four linguistic profiles and predictions to explain the variance in reading: i) children with typical phonological and non-phonological skills are expected to show no impairment in reading skills; ii) children with low phonological skills (and typical non-phonological skills) are expected to manifest dyslexia; iii) children with low phonological and non-phonological skills are expected to establish the DLD group; and iv) children with low non-phonological skills (and typical phonological skills) are expected to show poor comprehension skills with intact decoding skills. The profiles and hypotheses derived from this model, which mainly attribute reading difficulties

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of children with dyslexia and DLD to low phonological processing skills, were largely examined in English (Catts et al., 2005; Nash et al., 2013; Nation et al., 2010) relative to other languages, for example, Dutch (De Groot et al., 2015) and Greek (Talli et al., 2016).

The other view, the CLA, posits that the various linguistic (phonological and non-phonological) skills develop concomitantly and with relation to each other. Their overall interactions explain the significant variance in literacy and reading (Dickinson et al., 2003; Dickinson & McCabe, 2001). The results of different studies coincide with the premises of this approach showing a significant role for language skills in literacy and reading acquisition (Abu-Rabia, 2007; Asadi et al., 2016; Hansen, 2014; McKague et al., 2001; Mokhtari & Thompson, 2006; Nagy et al., 2006; Ramus, 2003; Saiegh-Haddad & Geva, 2008; Snowling et al., 2020).

To the best of our knowledge, no study in the Arabic clinical and educational contexts has investigated the reading performance of children with low linguistic skills based on the differentiation between phonological and language skills in kindergarten. This investigation would enhance understanding of the relations between different linguistic skills and reading and provide practical implications for early reading intervention. The motivation for the present study also derived from the linguistic and orthographic idiosyncrasies of Arabic as well as its diglossic nature. These particular features emphasize the need to examine in Arabic the reading and language-based theoretical frameworks that were originally derived from English data (Share, 2008).

The Arabic language

Arabic is the sixth most spoken language in the world with nearly 300 million speakers (Eberhard et al., 2019). It is written from right to left in an *abjad* or consonantal writing system (Daniels, 1992, 2018) and consists of two sets of graphic signs: horizontally arrayed letters and vertically arrayed extra-linear diacritic-like signs. This writing system consists of 29 letters. Twenty-eight of the 29 letters denote consonants (except */ʔalif/*). Three letters */ʔalif/, /ya:ʔ/,* and */wa:w/,* function as *matres lectionis* and represent both consonants and long vowels. As vowels, they are used to represent the three Arabic long vowels /i:/, /u:/, /a:/ (Saiegh-Haddad, 2013). In addition, *extra-lineal diacritic-like signs* are used extensively in Arabic and appear primarily above but at times below the letters. There are two classes of diacritizations: phonemic and morpho-syntactic (Saiegh-Haddad, 2018). The phonemic diacritization system consists of five major signs, three of which consistently map the three short vowels /a, u, i/ (respectively ـَ / ـُ / ـِ), one that denotes null vowelization (ـْ), and one that denotes consonant germination/lengthening (ـّ). In contrast, the morpho-syntactic diacritics consist of the three short vowels that can also appear word-finally along with other three extra-lineal signs, called nunation */tanwi:n/* (see, for details, Saiegh-Haddad & Henkin-Roitfarb, 2014).

Arabic writing system shares another essential feature which employs two versions of the same orthography differing in the amount of phonological information they supply: the phonologically transparent version is diacriticized (short vowelized) and mainly used in printed materials in the initial years of learning to read, generally

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up to the fourth grade, as well as in poetic texts and the Holy Scriptures (Saiegh-Haddad & Henkin-Roitfarb, 2014). All necessary phonological information is available in this script, and readers rely more on grapheme-to-phoneme conversion rules. The second version of the orthography, the default for Arabic readers, is the non-diacriticized (non-short vowelized) script, which relies on letters with no diacritic-like signs (for more details, refer to Bar-On et al., 2018). This non-diacriticized script illustrates two significant challenges: identifying the word encoded in the written string and resolving the homographic word. Hence, children can rely on the internal morphological structure of the words (Abu-Rabia, 2007; Saiegh-Haddad, 2013, 2018; Saiegh-Haddad & Geva, 2008), context cues, and prior knowledge (Abu-Rabia, 1996), utilizing parsing preference of familiar syntactic structures, sentence context (Hermena et al., 2015), and frequencies of the word forms (Grosvald et al., 2019) based on prior reading experience or probability for ambiguity (the number of words with the same orthographic form).

Reading in Arabic is also influenced by the diglossia (Ferguson, 1959) defined by the existence of two varieties of Arabic used under different conditions. While Standard Arabic (StA) is used in formal contexts and for reading and writing, Spoken Arabic (SpA) is used in everyday life and acquired naturally. These varieties show differences at all linguistic levels: phonology, lexicon, morphology, and syntax. The differences in phonological representations across the two varieties are thought to impact initial reading negatively (Saiegh-Haddad, 2003). This is because not all phonological units are explicitly accessible before reading acquisition starts. The absence of some literary phonological representations from the spoken lexicon [e.g., the StA phoneme /ث/ (θ) is often pronounced as /ت/ (t) in the SpA] illustrates the language availability problem when children are required to use the standard phonological representations in reading (Saiegh-Haddad & Henkin-Roitfarb, 2014). Another phonological distance relates to the architecture of the syllable. Saiegh-Haddad and Spolsky (2014) analyzed the spoken corpus of 5-year-old children who speak the central Palestinian dialect and the lexical basis of first- and second-grade textbooks (which represents the StA corpus). Results established that the predominant SpA syllable structures were CVC (51.8%), followed by CCVC (26.8%). However, in the StA, the most common syllable structures were CVCC (46%) and CVC (42%). This phonological distance complicates the development of PA and likely poses challenges for learning to read in Arabic. This complex effect of the diglossic constraint on reading even when the transparent script is used may enhance readers to rely on morphology while reading words. The nonlinear derivational morphological system with a majority of words comprised of a consonantal root (that provides the core meaning) and a word pattern (a fixed prosodic template that specifies the word's categorical meaning and some of the phonological characteristics of the surface form: vocalic, syllabic, and prosodic form) (Saiegh-Haddad, 2018) tunes readers from the initial phases of reading to extract morphological cues to access meaning. The role of morphological awareness in reading or spelling in Semitic languages (Arabic and Hebrew) was widely documented (Abu-Rabia, 2007; Mahfoudhi et al., 2010; Saiegh-Haddad, 2013; Saiegh-Haddad & Geva, 2008; Schiff & Ravid, 2007; Taha & Saiegh-Haddad, 2016; Taha & Taha, 2019). The contribution of morphological awareness in Arabic was found to be significant for both reading accuracy and fluency in first and fourth grades (Asadi et al., 2017),

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and also for reading accuracy of both real and pseudowords in third grade (Tibi & Kirby, 2017). In later stages (fourth and sixth grades), morphological awareness was a significant predictor for reading comprehension but not for word reading (Layes et al., 2017).

Besides diglossia, Arabic orthography introduces a set of additional challenges. The presence of short vowels above or below the letters, and coping with the specific visual-orthographic features of this writing system together with diverse writing rules, all add in perceptual load and slow down word processing (Eviatar & Ibrahim, 2014; Hansen, 2014; Ibrahim et al., 2002). For instance, letters' connectedness leads to visual changes of the basic form of the majority of letters according to their position and orthographic neighbors. This ligaturing has been shown to developmentally affect word recognition during the initial stages of reading acquisition, with non-connected words being faster and more accurate to read than connected ones (Khateb et al., 2014). Later, when readers become more proficient (more familiar with the connected forms, which statistically become considered more frequent), reading connected words becomes faster and more accurate than non-connected words (Khateb et al., 2013). Following these features, it is not surprising that low levels of decoding accuracy in the first elementary grades were reported when reading the transparent script (Abu-Ahmad et al., 2014; Hende, 2012).

It follows from the above literature that despite using the so-defined transparent orthographic script (with consistent spelling-to-sound mappings), reading acquisition in Arabic is a challenging process from the initial phases of elementary school. It implies that other linguistic factors beyond PA may be involved in reading. While recent research has shown that PA continues to play a consistent and important role in decoding the Arabic script (Abu-Rabia et al., 2003; Abu-Ahmad et al., 2014; Asaad & Eviatar, 2014; Mannai & Everatt, 2005; Saiegh-Haddad & Geva, 2008; Saiegh-Haddad & Taha, 2017; Taibah & Haynes, 2011) even in the highest elementary school (sixth) grade (Asadi et al., 2016), the contribution of language skills for the initial reading in Arabic were less studied. Although morphological awareness was considered to be an important factor in reading as it was mentioned above, the contribution of vocabulary to decoding and word reading was not significant in first grade (Asadi et al., 2017) and third grade where word, nonword, and paragraph reading were measured (Batnini & Uno, 2015). Moreover, while syntactic awareness has explained 11% of the variance in Arabic word reading in second grade (Abu-Ahmad et al., 2014), according to another study, its contribution was not significant to reading measures across the elementary grades (Asadi et al., 2017).

The current study

The goal of the present study is to shed new light on the contribution of phonological and language skills to the reading process in Arabic and to examine the compatibility of the theoretical models, the *two-dimensional model*, and the *CLA*, derived from English data to the case of Arabic. The study also aimed at estimating the correlation between the linguistic profiles and the proportion of reading difficulties. For these purposes, four distinct profiles of children were established based

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on different linguistic tasks in kindergarten: i) typical phonology and typical language, ii) low phonology, iii) low language (typical phonology), iv) low phonology and low language. All profiles were followed 1 year later at first grade to assess their reading achievements. Selecting this developmental stage using a longitudinal design allows following children with different linguistic profiles before the start of formal reading instruction (kindergarten) through establishing critical milestones in reading acquisition before reaching complex reading levels for comprehension (first grade). To approach the contribution of phonological and language skills to reading in Arabic, the following questions and hypotheses were specified:

1. Do children with low phonological skills, children with low language skills (intact phonological skills), and children with a double deficit (in kindergarten) differ significantly from typical children across decoding and word reading tasks (measured in first grade)?

Lower reading levels among two groups of children: those with low phonological skills and those with the double deficit, compared to children with typical language development and those with low language skills, will support the fundamental relationship between phonological skills and reading as hypothesized by the two-dimensional model. Yet, lower reading levels among three groups of children: those with low phonological skills, those with the double deficit, and those with low language skills, compared to children with typical language development, will accord with the CLA.

2. Do children with low phonological skills show significantly lower decoding and word reading performance than children with low language skills?

A positive answer will support the unique and central role of PA in reading. A negative answer, that is, no significant differences in reading across these profiles, will indicate that both phonological and language skills are crucial for reading, corroborating the CLA hypothesis.

3. Do children with the double deficit show significantly lower decoding and word reading performance than children with low phonological skills or low language skills?

Significantly lower reading levels among children with double deficit, compared only to children with low language skills, but not to children with low phonological skills will add support to the critical and unique role of phonological skills for reading. However, significantly lower reading levels among children in the double-deficit group, compared to children with low language skills and children with low phonological skills, will provide a support to an additive effect of language.

4. From a prospective view what is the prevalence of reading difficulties (measured in first grade) across different linguistic profiles (measured in kindergarten)?

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Method

Participants and procedure

A total of 1158 children from 73 kindergartens from the north district of Israel participated in this longitudinal two-phase study (kindergarten and first grade). Participants were all monolingual Arabic-speaking children. Of these, 561 were boys and 591 were girls; for the remaining six participants, gender value was not documented (*M* age in months = 68.71; *SD* = 3.4 in kindergarten). From this sample, four groups differing in linguistic proficiency were constituted in kindergarten and followed in first grade. Inclusion criteria for group selection are detailed below in the procedure section. The kindergartens included in the study were ranked low-middle socioeconomic status according to a welfare index ascribed to each kindergarten. The children differed in their Arabic-spoken dialects, roughly classified as rural, urban, and Bedouin. The similar dialects of the research assistants were considered in the assigning process to match their dialects to the dialects of the children as much as possible. This study was approved by the chief scientist of the Ministry of Education (file no' 9667) and the Research Ethics Committee of the Faculty of Education at the University of Haifa (approval no' 043/18). Parents provided informed written consent for their child to participate.

All children carried out different linguistic tasks in kindergarten (T_1). Of the total sample, 956 children were followed in first grade (T_2) to assess their reading skills. The linguistic tasks in T_1 were individually administered in a quiet room in the children's kindergarten in four separate sessions through January–May 2019. The reading tasks were carried out in two separate sessions through January–March 2020 in a quiet room in the children's school. In both phases, the order of the tasks within each session was counterbalanced across participants, but the order of the items per task was kept intact. The tasks were administered by research assistants who were graduate students from learning disabilities departments or holders of other relevant academic degrees. In both phases, all the research assistants participated in training sessions of several days to ensure they understood the instructions and administration procedures. The missing data for children in T_2 (N = 202) constitute a dropout percentage equal to 17.44%. These children did not participate in T_2 due to the spread of the coronavirus pandemic and the total shutdown of the education system in Israel in March 2020.

Measures

All the linguistic measures reported below were carried out in the spoken Arabic variety. Intraclass correlations reported below were based on an external sample (N = 40) of children from different kindergartens representing various spoken dialects. Examples of the task's items shown in supplementary materials (Appendix 1–14) can be retrieved by the following OSF's link: https://osf.io/fz6j4/.

Kindergarten's phonological measures

- **CV isolation**. Two subtests of this task were developed for the purpose of the study (Jabbour-Danial et al., 2018). One subtest included CV

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(consonant-vowel) isolation from two-syllable words composed of two structures: /CV.CVC/ and /CVC.CVC/. The children were asked to repeat the target word and then to isolate the initial syllabic or sub-syllabic unit (CV): [i.e., */qu:l dulfi:n/* ('say dolphin'), */bkilmet dulfi:n mnismaʕ bilʔawwal/* ('in the word dolphin we hear at first') _____ (correct responses: du/d/demi phoneme *ʔed*)/]. One example and four training items providing feedback were presented before the task started. This subtest included 12 items (maximum score = 12), intraclass correlation = .80, and Cronbach's alpha reliability = .79. The second subtest included CV isolation from one-syllable words of CVC structure. The same procedure was administered (maximum score = 10), intraclass correlation = .91, and Cronbach's alpha reliability = .80. A composite score of these two versions was calculated ($r = .54$, $p < .001$) with total alpha reliability = .81. Examples of the task's items are shown in Appendix 1.

- **Final sound isolation.** This task was developed for the purpose of the study (Abu-Ahmad et al., 2018a) and was administered twice at kindergarten. A composite score for both administrations was calculated, $r = .56$, $p < .001$. The children were asked to repeat the target word and then required to isolate the final consonant. All items were CVC words [i.e., */qu:l dob/* (say bear), */bkilmet dob mnismaʕ bilʔaxer/* (in the word bear we hear at the end) _____ (correct responses: b/demi phoneme *ʔeb*)]. One example and four training items providing feedback were presented before the task started (maximum score in each task = 12). Intraclass correlation = .94, .91 and Cronbach's alpha reliability = .85, .83 for the first and second tests, respectively, and total alpha reliability = .87. Examples of the task's items are shown in Appendix 2.
- **First sound isolation.** Two versions of this task were developed for the purpose of the study (Abu-Ahmad et al., 2018b), and a composite score was calculated, $r = .48$, $p < .001$. One task comprised words with CCVC syllabic structure, and the second task included words with CVC syllabic structure. The children were asked to repeat the target word and then required to isolate the initial consonant [i.e./*qu:l mra:y/* (say mirror), */bkilmet mra:y mnismaʕ bilʔawwal/* (in the word mirror we hear at first) _____ (correct responses: m/demi phoneme *ʔem*)/]. One example and four training items providing feedback were presented before the task started. Each subtest included 12 items (maximum score = 12), intraclass correlation = .84, .93, and Cronbach's alpha reliability = .76, .82 for the first and second subtests, respectively, and total alpha reliability = .84. Examples of the task's items are shown in Appendix 3.

Kindergarten's language measures

- **Vocabulary.** To assess expressive vocabulary, a picture naming task was adapted to Arabic based on the TAVOR test (Tavor, 2008) and administered twice in kindergarten. A composite score of both trials was calculated, $r = .41$, $p < .001$. Children were shown pictures of objects (such as a bridge), actions (such as "to knock") and adjectives (such as "angry"), and they were asked to

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name what they saw in each picture. Score 1 was given for each correct answer (maximum score = 11 and 12 for the first and second tests, respectively). Intraclass correlation = .91, .81 and Cronbach's alpha reliability = .55, .69 for the first and second tests, respectively, and total alpha reliability = .73. Examples of the task's items are shown in Appendix 4.

- **Noun-pluralization.** In this task developed for the purpose of the study (Joubran-Awwadia et al., 2018a), children were required to provide orally the spoken plural form (feminine sound plural, masculine sound plural, and broken plural) or the dual form of 15 nouns. The examiner presented to the child a picture of a single item (e.g., /*tuffa:ħa*/ 'apple'), and a picture of four items for the plural form (e.g., /*ʔarbaʕ tuffa:ħa:t*/ 'four apples') and says while pointing to each picture respectively: "Here, there is /*tuffa:ħa waħdi*/ 'one apple', and here there are four . . . " (expected answer: /*tuffa:ħa:t*/ 'apples'). This task included three feminine sound plural items (noun+ suffix a:t, e.g., /*tuffa:ħa:t*/ 'apples'), four broken plural items (e.g., /*kya:s*/ 'bags'), three masculine sound plural items (noun+ suffix i:n, e.g., /*mharʒi:n*/ 'clowns') and five dual items (noun+ suffix e:n, e.g., /*ʕasˁfu:re:n*/ 'two birds') (maximum score = 15), intraclass correlation = .74., and Cronbach's alpha reliability = .83. Examples of the task's items are shown in Appendix 5.
- **Verb-derivation.** In this task developed for the purpose of the study (Mansour-Adwan et al., 2018a), 12 sentences were presented orally to the child and s/he was required to complete the sentence with the correct derived form of the verb (e.g., /*eddahha:n*/ 'The painter'. . . . ; the expected answer is /*bidhan*/ 'paints'). Two examples and two training sentences were presented before the task started (maximum score = 12), intraclass correlation = .73, and Cronbach's alpha reliability = .70. Examples of the task's items are shown in Appendix 6.
- **Sentence repetition.** This task was developed for the purpose of the study to assess sensitivity to grammatical structures (Mansour-Adwan et al., 2018b). It was administered twice in kindergarten, and a composite score of both versions was calculated ($r = .38$, $p < .001$). Children were orally presented with different sentences at a rate of one word per second and were asked to repeat them verbatim, one sentence for each trial. In the first test, the sentences were presented orally by sound recording using E-prime software. Due to some technical problems, the research assistants orally presented sentences in the second test in real time. One practice item was given before the scored items were presented. The sentences consisted of five to eight words with various grammatical structures. The grammatical structures included compound sentences, a sentence with three successive verbs, relative clauses, sentences containing embedded clauses, and subordinating conjunctions; cause-relation clauses, conditional clauses, and direct speech. Responses were recorded, and a binary scoring system was implemented, that is, score one was given for each item if the child repeated all speech parts of the original sentence (consistent articulation errors were not considered for the scoring process). Any deviation from the original sentence rendered the entire sentence incorrect, with a score of 0. Dialectical articulation and phonological differences were not considered as errors (e.g., /*ʕalaʃa:n*/ instead of /*ʕaʃa:n*/ 'because').

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Research assistants were recommended to record the children's productions and listen to their recordings for the scoring process (maximum score = 8 and 13 for the first and second test). Intraclass correlation = .90 for the first test and Cronbach's alpha reliability = .72, .80 for the first and second tasks, respectively, and total alpha reliability = .83. Examples of the task's items are shown in Appendix 7.

- **Receptive syntax.** This task, based on the Clinical Evaluation of Language Fundamentals, CELF (Semel et al., 2000), was adapted to Arabic for the purpose of this study (Mansour-Adwan et al., 2018c). The children heard a sentence and were asked to point to the appropriate picture out of three possibilities. The target sentences were syntactically complex (conjunctions, relative clauses, adjectives, negative elements, and time clauses). This task included 12 items yielding thus a maximum score = 12, with intraclass correlation = .60 and Cronbach's alpha reliability = .57. Examples of the task's items are shown in Appendix 8.
- **Verb inflection using pseudo-root (ʃ.l.z).** This task, originally developed by Shalev-Leifer et al. (2016), was adapted to Arabic for the study (Joubran-Awwadia et al., 2018b). In this task, all pseudowords were verbs inflected from the pseudo-root (ʃ.l.z). This task includes 12 sentences which were orally presented to the child, and s/he was required to complete a parallel sentence with a morphological agreement for tense (past to present/present to past), number, gender, and person [e.g., */mba:reħ ʔana: ʃalazet* (yesterday I *ʃalazet*), *mba:reħ ʔintu:/* (yesterday you) _____ */ʃalaztu:/*]. Maximum score = 12, Intraclass correlation = .70, and Cronbach's alpha reliability = .83. Examples of the task's items are shown in Appendix 9.
- **Derivation of resultative adjectives from verbs.** In this task, also developed for the purpose of the study (Mansour-Adwan et al., 2018d), 12 sentences were presented orally along with a pair of pictures containing an event alongside an associative result. The child was required to complete the sentence with the correct derivation of the noun from the spoken verb, hence, the resultative adjective [i.e., */qassamu ttuffaħa/* (they cut the apple), */sˁaret ʔittuffaħa/* (the apple became) _____ */mqassame/maqsu:me/* (cut)]. One example and two training items were presented before the task started. Maximum score = 12, Intraclass correlation = .77, and Cronbach's alpha reliability = .77. Examples of the task's items are shown in Appendix 10.

First-grade reading fluency measures

In all reading tasks, time limit was fixed to maximum 3 min, and the scores were calculated by the number of correct items per minute. The values of Cronbach's alpha reliability for reading tasks are presented in Table 2.

- **CV units**. This task was developed for the purpose of this study (Abu-Ahmad et al., 2019). It included 18 CV units, half of them composed of consonant and long vowel (i.e., */da:/*) and the remaining items composed of consonant and short vowel (i.e., */ma/*). Two long vowels were used in this task:

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Table 1. Descriptive statistics for the different measures collected in kindergarten from the general sample

Measure	*N*	*M* %	*SD* %	Range %
Linguistic measures				
Vocabulary	1158	74.25	15.77	91.30
Noun pluralization	1158	69.05	24.36	100
Verb derivation	1158	82.36	18.43	100
Derivation of RA	1158	71.41	22.90	100
Receptive syntax	1158	72.34	17.94	91.67
Sentence repetition	1158	65.25	20.78	95.24
ʃl.z	945	49.27	29.27	100
Phonological measures				
CV isolation	1158	59.26	33.70	100
First sound isolation	990	70.91	27.28	91.67
Final sound isolation	1158	28.83	33.23	100

Note. Derivation of RA = derivation of resultative adjectives from verbs.
ʃl.z = Verb inflection using pseudo-root.

Table 2. Descriptive statistics for reading measures and nonverbal ability (T_2) based on the general sample

Measure	*N*	*M*	*SD*	Range	Cronbach's *α*
CV units	926	22.05	16.71	83.08	.89
Frequent words	929	10.22	9.60	71.43	.91
Pseudowords	868	5.98	6.52	93.43	.94
Complex words	877	4.08	4.47	29.03	.97
Nonverbal ability	902	9.56	2.84	18	—

Note. The means in all reading measures are represented by the number of correct items per minute.

/a:/ and /u:/. No items included the long vowel /i:/ because children were not yet formally exposed to this vowel by their formal Arabic instruction books during the testing period of the school year. The same consideration of familiarity was implemented for the short vowels including only the two short vowels /*fatḥa*/◌َ/ (for /a/) and /*ḍ*ˁ*amma* /◌ُ/ (for /u/) but not /*kasra*/◌ِ/ (for /i/). For letters, familiarity (based on the curriculum) and a frequency consideration were also taken into account (Boudelaa et al., 2020). The children were instructed to read aloud these units in a clear voice, as fast and accurate as possible, while paying attention to diacritics. The intraclass correlation = .81. Examples of the task's items are shown in Appendix 11.

- **Frequent words.** This task, developed for this study (Jabbour-Danial et al., 2019), relied on four reading instruction books to determine the most common

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words and syllable structures. Based on the curriculum of the first instruction semester, 25 words (21 nouns, 4 verbs) were composed for this task: 5 words had CVC structure [e.g., /da:r/ ('house')], 4 words had CV.CV.CV structure [e.g., /*rasama*/ ('drew'), 12 words had CV.CVC structure [e.g., /*raza:n*/ ('Razan, a given name')], and 4 words had CV.CV structure [e.g., /*fa:di:*/ ('Fadi:, a given name')]. The lexical status of the words: 76% identical, 16% cognates, and 8% unique for StA. Children were instructed to read aloud these words in a clear voice, as fast and accurate as possible, and to pay attention to diacritics. The intraclass correlation = .82. Examples of the task's items are shown in Appendix 12.

- **Complex words.** This task was developed for this study (Mansour-Adwan et al., 2019) to assess reading skills from a developmental point of view. It consisted of different words rated at different levels of syllabic and morphological complexity, fitting the curricular sequence of the first and second grades[1]. The task included 50 words: 34 nouns and 16 verbs. These words consisted of different levels of syllabic structure complexity for nouns [e.g., CV.CVC /*ʕinab*/ ('grapes') and CVC.CV.CVC /*burtuqa:l*/ ('orange')] for simple and complex structures, respectively. This consideration was also drawn for verbs [e.g., CV.CV /*ʒa:ʔa*/ ('came') and CV.CV.CV /*ʃariba*/ ('drank')]. Furthermore, different morphological complexity levels were also considered for nouns [e.g., CV.CVC /*xaru:f*/ ('sheep') and CV.CVC /*θi:ra:n*/ (for the broken plural of the word 'bulls')] and for verbs [e.g., CV.CV.CV /*ʃariba*/ ('drank'- pattern 1) and CV.CV.CV /*sa:ʕada*/ ('helped'-pattern 3)]. The lexical status of the words: 56% cognates, 30% identical, and 14% unique for StA. Children were instructed to read aloud these words in a clear voice, as fast and accurate as possible, and to pay attention to diacritics. The intraclass correlation = .83. Examples of the task's items are shown in Appendix 13.
- **Pseudowords.** In this task (Joubran-Awwadia et al., 2019), all frequent words (derived from the second task) were modified in such a way that letters in words were reversed in their order or substituted with other letters to transform the real words into pseudowords. No change was made to the syllabic structure of the words. The same instructions as the previous tasks were presented to children but emphasized that these words have no meaning. The score was also calculated in the same manner. The intraclass correlation = .85. Examples of the task's items are shown in Appendix 14.

First-grade cognitive measure

- **General nonverbal ability.** A colored, shortened version of Raven's Progressive Matrices (Raven et al., 1998) was administered to assess children's nonverbal ability. Participants were asked to select the missing element of a presented pattern in 18 trials of increasing difficulty: six items were selected from each set (A, B, and AB). Maximum score = 18.

Data analysis and groups selection

The participants' scores in all linguistic tasks administered in kindergarten (hereafter T_1) were subjected to a factor analysis. All these tasks were loaded into two

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distinct factors: the first factor represented language skills and included vocabulary, noun-pluralization, verb derivation, derivation of resultative adjectives from verbs, receptive syntax, sentence repetition, and verb inflection using pseudo-roots with the following loading values: .73, .71, .68, .68, .66, .53, and .53, respectively. The second factor represented PA skills and included CV isolation, first sound isolation and final sound isolation tasks with the following loading values: .78, .74, and .68, respectively. Following this analysis, two composite scores were calculated separately for phonological and language skills and were utilized to constitute four linguistic profile groups in kindergarten based on standard cutoffs[2] used in the literature:

1. Group of typical linguistic skills and typical PA skills (hereafter T_LT_{Ph}): This group comprised children whose composite scores for phonological and language skills were both in between the 35th and 65th percentiles[3] ($N = 135$).
2. Group of low PA skills (hereafter L_{Ph}). The children in this group scored below the 25th percentile in the PA composite score ($N = 120$) and above the 35th percentile in the language composite score (i.e., typical achievement in linguistic tasks).
3. Group of low linguistic skills (hereafter L_L). Children in this group gained a composite score below the 25th percentile in the language domain ($N = 111$) and above the 35th percentile in the PA composite score (i.e., typical phonological skills).
4. Group of low linguistic and low phonological skills (here after L_LL_{Ph}). This group comprised children whose composite scores in both domains were below the 25th percentile ($N = 139$).

Similarly, two reading profiles were constituted in the first grade after computing a composite score based on all four reading tasks: CV units, frequent words, complex words, and pseudowords (see Table 3 for correlations):

1. A group of typical readers (hereafter T_R) included children whose reading composite score ranged between the 35th and 65th percentile.
2. A group with low reading skills (hereafter L_R) comprised children who gained a composite reading score below the 25th percentile.

Statistical analysis

Descriptive statistics are separately reported for linguistic and reading measures. Correlations between the reading tasks at first grade and the phonological and language tasks measured at kindergarten were also computed. To examine the differences between different linguistic profiles in reading measures beyond nonverbal ability, a multivariate analysis of covariance (MANCOVA) was conducted. Furthermore, a cross-tabulation procedure was used to describe the relationship between the two categorical variables (linguistic and reading profiles).

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Table 3. Correlations between phonological, language, and reading tasks

Measures	1	2	3	4	5	6
1. Phonological tasks[a]	—					
2. Language tasks[a]	.53**	—				
3. CV units[b]	.46**	.32**	—			
4. Frequent words[b]	.45**	.29**	.78**	—		
5. Pseudowords[b]	.48**	.31**	.78**	.88**	—	
6. Complex words[b]	.49**	.30**	.76**	.87**	.90**	—

**$p < .01$. Phonological (1) and language (2) tasks refer to composite scores for measures collected in kindergarten. All reading measures (3 to 6) collected in first grade refer to correct words per 1 minute. [a] = kindergarten. [b] = first grade.

Results

The descriptive statistics for the different PA and language measures that were collected in T_1 (kindergarten) are presented in Table 1. The mean scores for the phonological tasks range from ∼29% to ∼71%, and the linguistic scores range from ∼49% to 82%. In the phonological domain, lower scores were obtained for the final sound isolation task, while the highest scores were obtained for the first sound isolation. In the language domain, lower scores were obtained for verb inflection using pseudo-roots, and the highest scores were obtained for verb derivation. Descriptive statistics for reading tasks are presented in Table 2. It shows that the lowest scores were obtained for reading complex words, while the highest scores were obtained for reading CV units. Table 3 shows the correlation between the reading measures collected in first grade and phonological and language composite scores computed from kindergarten measures. This analysis showed high correlations between the different reading measures.

Interestingly, and as could also be expected, the highest correlation was found between reading pseudowords and complex words, confirming that the higher the child's decoding ability, the better his/her performance in reading complex words. We hypothesize that both tasks required a high degree of decipherability in this early reading stage. In addition, this analysis showed that, although both phonological and language composite scores positively correlated with reading tasks, correlations were found to be higher with the phonological (that included CV isolation, first, and final sound isolation) than with the language measures, attesting of the important well-established link between reading and phonology already during this very early stage of literacy acquisition.

Table 4 presents the descriptive statistics of the four reading measures as a function of the kindergarten linguistic profile (labeled as A to D). A MANCOVA analysis was conducted to examine whether the different linguistic profiles in kindergarten differed statistically in their reading fluency assessed by the different reading measures. This analysis showed a significant effect for group, $F(12, 918.37) = 2.96$, $p < .001$, Wilks'$\Lambda = .90$, Partial $\eta^2 = .03$) indicating a statistically significant adjusted mean difference between the different linguistic profiles in all reading measures after controlling for nonverbal ability (assessed by RAVEN, used

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as a covariate). Pairwise comparisons using Bonferroni tests indicated that the L_LL_{Ph} (group D) performed significantly lower than all the other groups (T_LT_{Ph}, L_{Ph}, L_L) in reading CV units and pseudowords. In reading frequent words and complex words, the L_LL_{Ph} group exhibited significantly lower scores than T_LT_{Ph} and L_L groups, still marginally significant difference was observed in reading complex words ($p = .06$) between L_LL_{Ph} (D) and L_{Ph} (B).

In the next step, we examined the relationship and the statistical overlap between the linguistic profiles constituted in T1 and the two reading profiles (T_R and L_R) constituted in T2. Chi-Square test[4] reveals a significant relationship between linguistic profiles in kindergarten and reading profiles in first grade ($\chi^2_{(3)} = 102.86$, $p < .001$). To understand this relationship, we used cross-tabulation analysis (see Table 5), which indicated that while the majority of children with T_LT_{Ph} (85.5%) and the minority of children with L_LL_{Ph} (37%) had typical reading skills in first grade, only small group of children with T_LT_{Ph} (14.5%) but the majority of children with L_LL_{Ph} (63%) had low reading skills. Similar trends were observed for the L_{Ph} and L_L profiles: one-third of the children in each group showed low reading skills, whereas two-thirds showed typical reading skills. Risk ratio analysis indicated that a child with L_LL_{Ph} is 4.93 times more likely to be L_R than a control child from the T_LT_{Ph} group. A child with L_L is 2.69 times more likely to be L_R than a control child from the T_LT_{Ph} group, and finally, a child with L_{Ph} is 1.81 times more likely to be L_R than a control child from the T_LT_{Ph} group. Overall, a higher prevalence of reading difficulties among the L_LL_{Ph} group was found, almost twice the prevalence of reading difficulties among other groups (L_L and L_{Ph}).

Discussion

This study investigated the prospective effects of early phonological and language skills on reading. More specifically, it aimed to reveal the reading achievement (assessed at first grade) of children assigned to different linguistic profiles (T_LT_{Ph}, L_{Ph}, L_L, and L_LL_{Ph}) at kindergarten. The profiles' constitution was based on the differentiation between phonological and language skills inspired by the two-dimensional model (Bishop & Snowling, 2004). Exploring the prevalence of reading difficulties across these profiles was an additional study interest. The overall findings of this study are as follows: 1) the L_LL_{Ph} was the only group to differ significantly from T_LT_{Ph} group across reading tasks; 2) children with L_{Ph} did not significantly differ in reading achievements from children with L_L despite their lower raw scores; 3) children with L_LL_{Ph} gained significantly lower scores than children with L_L in all reading tasks and compared to children with L_{Ph} in half of the tasks; and 4) prevalence estimates indicated that most children with L_LL_{Ph} (63%) and about a third of the children with L_L and L_{Ph} showed reading difficulties. These results bring new data in Arabic to bear on the role of language skills for decoding and word reading beside the widely accepted part of phonological skills. These findings will be discussed further below.

Differences in reading measures across linguistic profiles

In addition to the higher positive correlations between PA skills and reading measures supporting previous findings in Arabic (Asadi et al., 2017; Asadi & Khateb,

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Table 4. Descriptive statistics (means and standard deviations), one-way ANOVA on reading measures as a function of kindergarten profiles, and pairwise comparisons

Measure	General sample (G1)	T_LT_{Ph} (A)	L_{Ph} (B)	L_L (C)	L_LL_{Ph} (D)	*F*	η^2	PWC
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*			
CV units	22.05 (16.71) N = 926	20.90 (13.66) N = 103	18.31 (15.13) N = 96	20.31 (17.28) N = 90	10.83 (9.86) N = 107	8.20***	.07	A > D*** B > D** C > D***
Frequent words	10.22 (9.60) N = 929	8.96 (6.83) N = 103	7.78 (8.88) N = 97	9.17 (8.31) N = 89	4.57 (4.83) N = 111	6.97***	.06	A > D** C > D***
Pseudowords	5.98 (6.52) N = 868	4.70 (4.56) N = 97	4.11 (4.71) N = 91	5.31 (5.96) N = 80	1.94 (3.44) N = 102	8.41***	.07	A > D** B > D* C > D***
Complex words	4.08 (4.47) N = 877	3.20 (2.72) N = 96	2.62 (3.13) N = 92	3.48 (3.88) N = 80	1.45 (2.29) N = 100	6.64***	.05	A > D** C > D***

Note. Reading measures (administered in first grade) refer to number of correct words in 1 minute. T_LT_{Ph} = typical language and typical phonological skills. L_{Ph} = low phonological skills. L_L = low language skills. L_LL_{Ph} = low language and phonological skills. PWC = pairwise comparisons (Bonferroni-corrected).
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 5. The cross-tabulation of linguistic profiles in kindergarten and reading profiles in first grade

	T_R	L_R	Total
T_LT_{Ph}	85.5%	14.5%	100%
	N = 367	N = 62	N = 429
L_{Ph}	64.4%	35.6%	100%
	N = 58	N = 32	N = 90
L_L	65%	35%	100%
	N = 52	N = 28	N = 80
L_LL_{Ph}	37%	63%	100%
	N = 34	N = 58	N = 92

Note. T_R = typical reading skills. L_R = low reading skills.

2017; Tibi & Kirby, 2018) and across languages (Ziegler et al., 2010), somewhat milder but still significant correlations were found between language composite measure and reading measures. These correlations support the profiles' comparisons across reading tasks. It had been found that children with L_LL_{Ph} obtained the lowest scores on all reading assignments. Of particular interest from a clinical perspective, statistically significant differences were found between L_LL_{Ph} group and all other groups in two out of four reading tasks: CV units and pseudowords. The potential ability of the CV reading task to differentiate between the L_LL_{Ph} group and all other groups highlights the underlying role this unit has in Semitic languages (Saiegh-Haddad, 2003; Share & Blum, 2005; Tadmor-Troyansky, 2019) as well as many other languages such as Spanish and Italian (Goswami, 2010). The findings that only children with L_LL_{Ph} differed significantly from typical children after controlling for nonverbal ability, and that the L_{Ph} group did not significantly differ from the T_LT_{Ph}/L_L groups in any reading tasks, emphasize that both phonological and other linguistic skills are critical for reading acquisition among Arabic-speaking children. Also, the finding that children with L_LL_{Ph} gained significantly lower reading scores than children with L_L (in all reading tasks) and children with L_{Ph} (in half of the tasks) imply that lower reading scores among children with L_LL_{Ph} cannot be attributed exclusively to phonological skills. Alternatively, these results support multiple risk factors for reading difficulties, including both phonological and language skills.

The significantly low reading achievements of children with L_LL_{Ph} imply that children with low scores in only one domain (e.g., PA or language) would not gain reading scores worse than the low linguistic combined profile. The contribution of the language skills even when the diacriticized script is used (and which could be precisely deciphered by grapheme-to-phoneme correspondence rules) supports the notion that the information that is extracted from the writing system involves complex relations of orthography, phonology, morphology, and meaning (Frost, 2012), suggesting that "....the actual computation of an orthographic code in a given language is determined on-line by the transparency of mapping of graphemes into phonemes on the one hand, and by morphological and semantic considerations on the other hand, given the language properties in which reading occurs" (Frost, 2012, p. 23).

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The current results also support the hypotheses derived from the CLA, suggesting a critical role for various oral language skills in reading achievements (Dickinson et al., 2003; Dickinson & McCabe, 2001). In Arabic, despite the little support for the unique contribution of vocabulary to reading (Asadi et al., 2017; Batnini & Uno, 2015), a unique contribution for syntactic (Abu-Ahmad et al., 2014) and morphological awareness skills for word reading across different ages was documented (Abu-Rabia, 2007; El Akiki & Content, 2020; Schiff & Saiegh-Haddad, 2018; Taha & Taha, 2019; Tibi & Kirby, 2017, 2019; Wattad & Abu Rabia, 2020). We agree that overemphasizing the phonological processing skills in many studies to the extent that other linguistic skills are underestimated is methodologically risky (Bishop, 1991; Bishop & Adams, 1990; Storch & Whitehurst, 2002). Other language skills are important for top-down strategies that likely to contribute to word recognition and orthographic learning (Share, 1995). The prominence of root consonants and word pattern morphemes in Arabic seems to enhance deciphering printed words at a very early stage of reading establishment (Bar-On et al., 2018; Shalhoub-Awwad & Leikin, 2016). Although the current study did not examine the effect of diglossia on the contribution of phonological and language skills to reading, it would be interesting to test in the future if the role of these linguistic skills differs across reading words with different lexical statuses (identical words, cognates, and unique StA words).

The prevalence estimates of reading difficulties across linguistic profiles

The results of the current study indicated that low reading level was observed in about two-thirds (63%) of the children with L_LL_{Ph} and one-third with L_{Ph} and L_L. From a practical perspective, these results highlight the importance of early identification of children with low linguistic abilities before they met academic failures in reading and writing experiences. Very recently, it was proposed that, because of the hidden nature of DLD that leads to under-identification of these children, an active involvement of speech language pathologists (SLPs) and collaboration between them and teachers in educational contexts would help to accurately flag children with potential language difficulties (McGregor, 2020). From a theoretical standpoint, the significantly low reading achievements of children with L_LL_{Ph} (that may have resembled children with DLD) and the manifestation of low reading levels in the majority of them contradict the comorbidity model (Catts et al., 2005) that predicts a relatively low overlap between dyslexia and DLD, since phonological deficits and word reading problems were not assumed to characterize the latter group. In this respect, the present findings align better with the higher overlap estimates predicted by the two-dimensional model (Bishop & Snowling, 2004). However, the conservative interpretation of this model's prediction is that children with DLD would always have dyslexia with no existence of children with only DLD (Ramus et al., 2013). The current results do not support the perfect overlap between DLD and poor reading, since 37% of children with L_LL_{Ph} had intact reading skills. Since our low scores on language and reading were determined by the cutoff criteria of 25th percentile, children with relatively mild linguistic "deficit" might be part of the P_L and P_LP_{Ph} profiles. We suggest that the ascription of such children might increase the probability of intact reading among these profiles. Furthermore, the

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phase at which the reading abilities were assessed (in the middle of first grade) might not be sensitive enough to differentiate between good and poor readers since typical readers still acquiring reading milestone. Also, considering the variability of methodological methods, tasks' repertoire, and sampling across studies, this conservative assumption becomes practically undefendable.

Adopting a data-driven approach that quantitatively proposes an estimated prevalence of reading difficulties among children with L_LL_{Ph} would be more suitable because it informs an already existing large body of studies. More particularly in English, prevalence estimates of 36.8% (Young et al., 2002), 48% (Snowling et al., 2020), 43% (Snowling et al., 2019), and even 51% (McArthur et al., 2000) were reported. Relative to other reports, the relatively high prevalence of low reading levels observed here among children with the L_LL_{Ph} can be attributed to the binding of PA and language skills in the inclusion criteria for this group. Indeed, in contrast with the binding implemented in the current study, the weight given to phonological skills in defining DLD differs across studies. In addition, given the fact that no discrepancy criterion between IQ and achievement scores was included in the current study may also affect (enlarge) the observed overlap. The controversy regarding this criterion is still up to date (for more details, refer to Adlof & Hogan, 2018; Catts et al., 1999; Tannock, 2013).

However, it should be noted that despite the differences in prevalence estimates between studies, the reported values still align well with the frequently co-occurrence wide range of 17%–71% found across studies. These differences could be attributed to sampling differences (clinically referred samples vs. epidemiological studies), differences in time point of diagnosis (parallel or consecutively) (Adlof & Hogan, 2018), or other methodological issues such as inclusion criteria and definitions. The risk ratio to having low reading skills among children with language difficulties found in our study is not exceptional (L_LL_{Ph} is 4.93 times more likely to display reading difficulties than T_LT_{Ph}) compared to previous findings. A previous study had reported a risk ratio of 4.6 for reading disabilities 14 years after DLD was identified (Young et al., 2002). It appears clear from the results reported here that low linguistic skills in kindergarten place a child at substantial risk of later reading difficulties and academic vulnerability.

Limitations

The results of the current study represent, to our knowledge, the first evidence of assessing reading skills in Arabic-speaking children with different linguistic profiles. Any conclusion in this context must be formulated with some caution. First, because the phonological tasks used here were limited to isolation tasks that might not be the best reliable combination to represent the PA construct at this assessment time (kindergarten: before formal reading) (Mansour-Adwan et al., 2020). Hence, future studies should assess the overlap between L_{Ph} and L_R groups based on different phonological tasks (e.g., syllable/phoneme deletion tasks or blending tasks). Second, the current measures were drawn upon only one component of phonological processing, with no reference to verbal short-term memory, working memory, automatized rapid naming, or other skills that might be crucial for decoding written words and for differentiating between children with DLD and children with dyslexia (Bishop et al., 2009; Ramus

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et al., 2013). It had been found that rapid naming has differentiated children with DLD from children with DLD + dyslexia and was more related to reading than to language (Bishop et al., 2009). Third, the fact that the frequency of items unique for StA was not completely balanced across reading tasks (8% and 14% for the frequent and complex words, respectively) might unintentionally influenced the difficulty level of these tasks beyond the syllabic and morphological complexity of the words. Fourth, we suggest treating the current linguistic and reading categorizations carefully, since we know little at this phase about the stability of these groups over time. As a previous study has shown, measuring reading status stability between second and eighth grade revealed that only less than half of the children met the criteria for persistent reading disorders, besides significant proportions of children who were late-emerge reading disordered or others who had resolved their reading disorders (Torppa et al., 2015). The stability of the phonological deficit is vital because resolved deficiency of this domain among children with DLD was previously reported alongside their relatively good decoding skills (Bishop et al., 2009; Snowling et al., 2019, 2020). Finally, the unique contribution for each of the oral language skills to reading cannot be inferred due to the nature of the specific methodology of a multivariate language-based achievement. In this regard, previous studies imply that the correlations between unitary linguistic domains and reading would be much weaker relative to a composite measure of oral language (Catts et al., 1999). For a synthetic language with rich and dense morphology, such as Arabic (Tibi & Kirby, 2019; Tibi & Kirby, 2017, Wattad & Abu Rabia, 2020), morphology might be neglected and undermined when grouping language skills together. To disentangle the effect of morphology from vocabulary and syntax, we suggest examining the probability of reading difficulties among children with low morphological skills, children with low non-morphological skills, children with low syntactic skills, and children with low non-syntactic skills.

Conclusions

This longitudinal study showed that establishing linguistic profiles in kindergarten based on the distinction between phonological and language skills allowed the identification of children with $L_L L_{Ph}$ that appeared to be the most at risk for reading difficulties 1 year later. The low performance of this "double-deficit" group relative to "single-deficit" groups (L_L, L_{Ph}) provided evidence in support of the CLA, indicating that language skills, as well as phonological skills, significantly affect reading skills in first grade. We propose that children with low phonological and language skills are undoubtedly inferior in reading, which may increase their academic vulnerability. The high prevalence of reading difficulties among this group of children confirms that early language skills and reading are tightly related and that early language interventions are essential.

Supplementary material. For supplementary material accompanying this paper visit https://doi.org/10.1017/S014271642300019X

Replication package. The data and code required to replicate all analyses in this article are available at https://osf.io/fz6j4/

Acknowledgments. This work was supported by the Israeli Science Foundation (Grant no' 2695/19) and by the Edmond J. Safra Brain Research Center for the Study of Learning Disabilities.

Notes

1 Three considerations have guided the words' selection of this task: morphological complexity, syllable structure complexity, and affinity to teaching materials. Since no explicit attempt was done to control for the resulted phonological variations, unbalanced distribution of short and long vowels across words might be a confounding factor.

2 Using the 25 percentile cut-off for poor achievement is based on previous literature on learning and reading disabilities (Asadi & Shany, 2018; Fletcher et al., 1994; Shany & Breznitz, 2011; Shany & Share, 2011; Stanovich & Siegel, 1994; Young et al., 2002).

3 Using scores between the 35th–65th percentiles in both phonological and non-phonological skills was designated to reduce the chances for group effect (when the T_LT_{Ph} group compared to the low groups) owing to the range of particularly high scores of these measures.

4 In this specific analysis we expand the inclusion criteria for T_LT_{Ph} to include children whose phonological and language scores were above the 35th percentile (instead of 35th–65th percentile cut-off) since no dependent variable (e.g., reading) was compared here across linguistic tasks.

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Cite this article: Mansour-Adwan, J., Shalhoub-Awwad, Y., Cohen-Mimran, R., and Khateb, A. (2023). Reading in kindergarten Arabic-speaking children with low linguistic skills: A longitudinal study. *Applied Psycholinguistics* **44**, 265–291. https://doi.org/10.1017/S014271642300019X